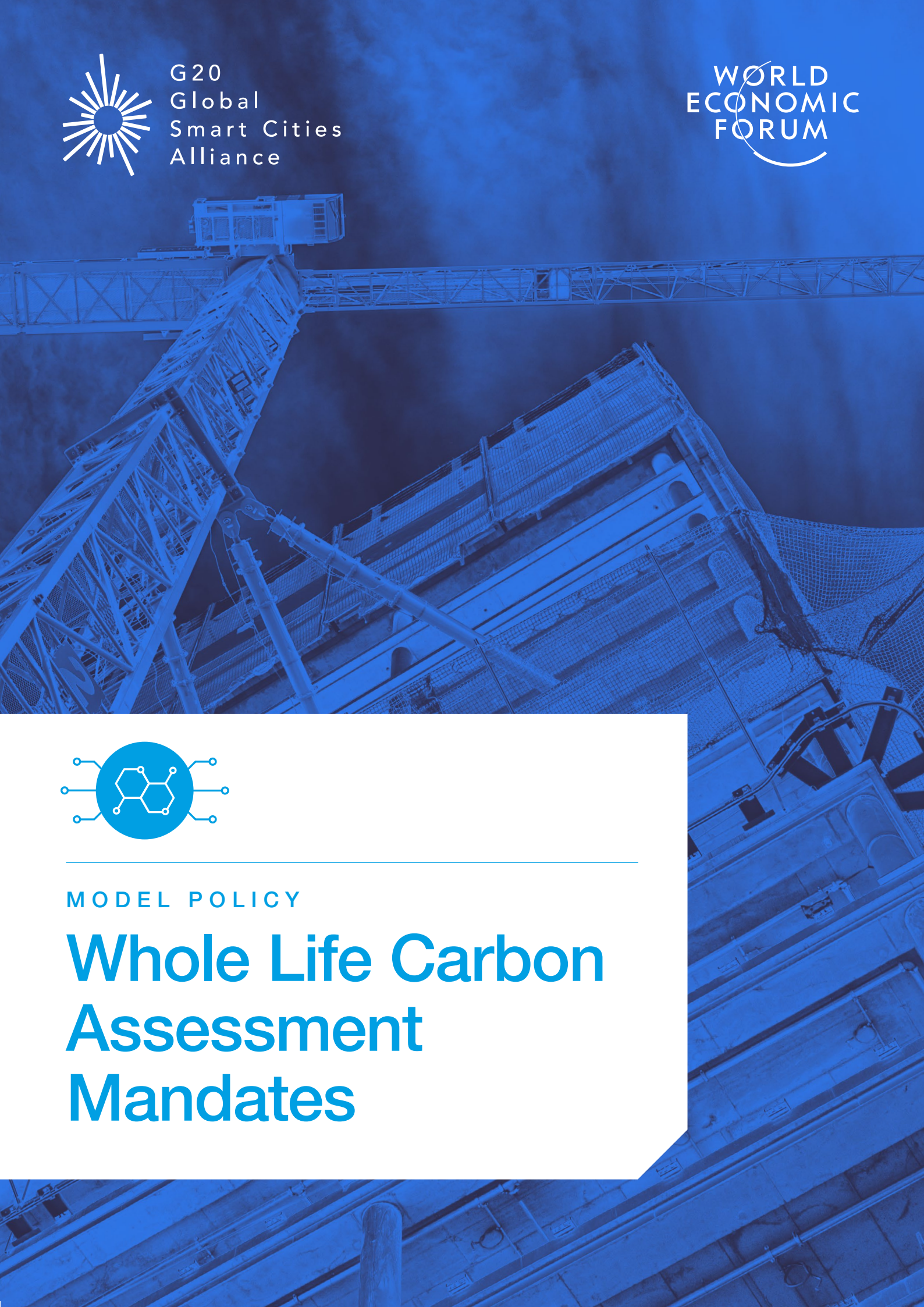
G20 Global Smart Cities Alliance

WORLD ECONOMIC FORUM



MODEL POLICY

Whole Life Carbon Assessment Mandates

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This policy is considered foundational to the G20 Global Smart Cities Alliance policy roadmap. You can find supplementary content on our website to provide practical support for adopting and implementing this policy.

How to use this model policy

Introduction

Whole life carbon (WLC) is defined as the entire amount of carbon produced by any particular built asset.[1] It is composed of two main sources of emissions: operational and embodied.

Operational carbon refers to carbon that is produced by the built asset's day-to-day occupancy and use, such as heating and cooling, lights, equipment, etc. Embodied carbon refers to the carbon emissions associated with the extraction, manufacturing, transportation, installation, maintenance and disposal of building materials.

The World Building Council for Sustainable Development (WBCSD) and Arup report that embodied emissions account for approximately 50% of an average building's whole life emissions, and most of them occur before anyone even sets foot in the building.[2]

Urbanization is rapidly increasing with Global Construction Source finding that by 2050 another 2.5 billion people are expected to live in urban areas.[3] While the demand for cities and space is a major source of carbon emissions, there is an opportunity to ensure building construction takes on more sustainable practices.

One of the first steps cities can take is to understand the full carbon footprint of its built environment, starting from pre-construction through to demolition, as well as how urban development measures, accounts for and uses carbon, particularly embodied carbon.

In this policy brief, embodied carbon means emissions related to the extraction of raw materials, their manufacturing, assembly during construction, any maintenance or replacements, the disassembly and demolition, and any associated transport, waste and end-of-life impacts.

Policy-makers can use this document as a template for their own WLC assessment policy. Italicized words/phrases should be contextualized to city specifics and broad definitions such as "major developments" or "nationally or regionally" climate policy and regulations.

Objective

The objective of this model policy is to help cities draft legislation requiring WLC assessments for major developments in the built environment. While there are a variety of interpretations of the term "major development" and as much variety in the criteria to define them, major development is defined here as any work that requires planning approval. This includes retrofits, renovation, refurbishment and new construction.[4]

Cities adopting this policy model would take a decisive step to reduce the carbon footprint of their built environment and reach their climate-neutrality and net-zero emissions targets. By adopting this policy, cities would also meet some of the leadership commitments of the C40 Cities Accelerators: Net Zero Buildings Accelerator and Clean Construction Accelerator.

RICS, one of the major assessment standards,[5] describes whole life carbon assessments (WLCA)[6] as a fundamental aid to decision-making during the design and procurement phases of a project. A WLCA not only helps identify the significant causes of carbon impacts for a project, but has other benefits, such as supporting long-term life cycle thinking beyond project completion and encouraging a fuller, more detailed understanding of the supply chain.[7]

How this policy was developed

These guidelines were developed by the Sustainability and Smart Cities Taskforce led by the World Economic Forum's G20 Global Smart Cities Alliance in collaboration with Infosys Ltd. and C40 Cities.

Policy wording is derived from existing policies, including:

1. The London Plan 2021 Policy, Section 9 Sustainable Infrastructure Chapter 2 "Minimising greenhouse gas emissions".

2. Appendix K: Embodied Carbon Strategy of the Vancouver Climate Emergency Action Plan.

3. Toronto Green Standard V4.

4. CNCA City Policy Framework.

5. CaGBC Zero Carbon Building Standard.

Additional relevant policy examples can be found in the C40 Cities Clean Construction Policy Explorer.

The Sustainability and Smart Cities taskforce provided input on relevant policies that are being tried and tested by cities. These policies were agreed upon to uphold the most relevant and useful parts of whole life carbon assessments to help cities reach their sustainability and embodied carbon goals.

Model policy

Main principles

1

Major development proposals, as defined in the local context, referable to the city's governing body, must calculate whole life-cycle carbon emissions through a nationally recognised Whole Life Carbon Assessment[8] and demonstrate actions taken to reduce life-cycle carbon emissions.

2

A city's major developments, as defined in the local context, must reduce the carbon attributed to operational energy to strive towards becoming a net-zero city. This can be accomplished in accordance with the following energy hierarchy (Figure 1):

- *Be lean:* use less energy and manage demand during operation.
- *Be clean:* exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly. Any fossil fuel driven technology is not compliant with the "be clean" step of the hierarchy.
- *Be green:* maximize opportunities for renewable energy by producing, storing and using renewable energy on site.
- *Be seen:* monitor, verify and report on energy performance city-wide.[9]

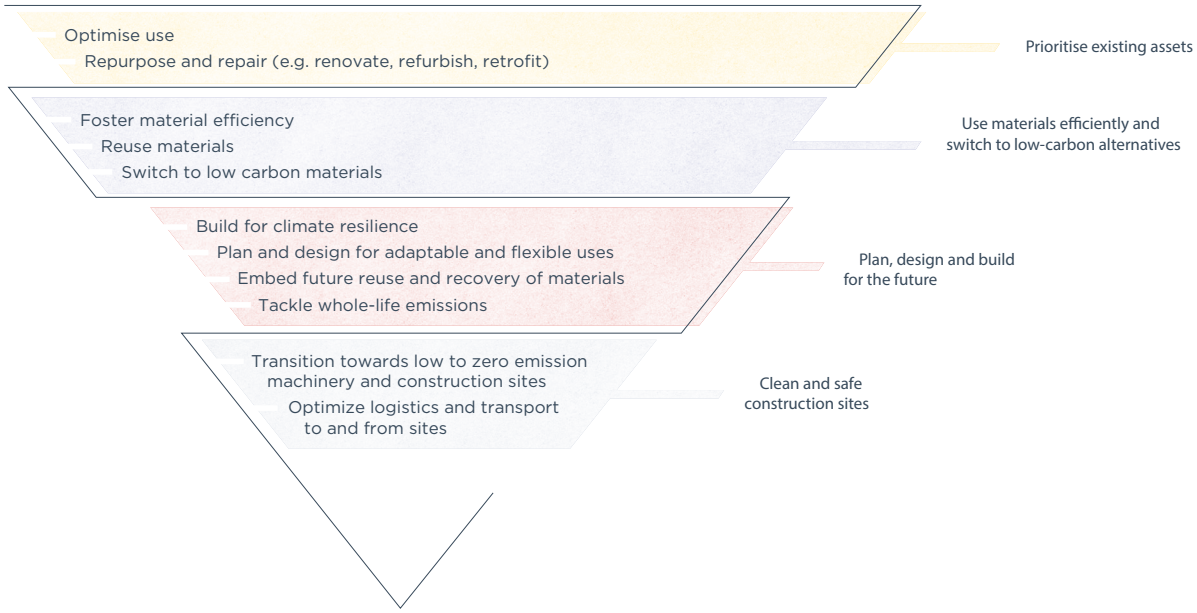
3

A city's major developments, as defined in the local context, must reduce its embodied carbon to strive towards becoming net zero. This can be done in accordance with the following embodied carbon reduction hierarchy (Figure 2):[10]

- Prioritize existing assets by optimizing current development use and repurposing and/or repairing instead of demolition.
- Use materials efficiently and switch to low-carbon alternatives. Example actions include fostering material efficiency, reuse materials and switching to low-carbon materials.
- Plan, design and build for the future. From the planning stage, build for climate resilience, design for adaptable and flexible uses, and embed future reuse and recovery of used materials. All of these actions help to tackle whole-life emissions.
- Prioritize clean and safe construction sites. Transition towards low-to-zero emission machinery and construction sites and optimize logistics and transport to and from sites.

Figure 1: The energy hierarchy

Figure 2: Embodied carbon reduction hierarchy[13]



Source: C40 Cities, Copyright: C40 Cities

Supporting principles

1.1 [City] is committed to become a *net- zero carbon city.*[11] This will require reduction of all greenhouse gases, of which carbon dioxide is the most prominent. If the objective of becoming a net-zero carbon city before *2050* is to be realized, major development needs to meet the requirements of this policy.

1.2 Whole life carbon assessments (WLCA) are therefore required for major development proposals referable to the *insert governing body*. *Insert city or governing body non-referable developmen*t are encouraged to undertake WLCAs. The approach to such assessments, including when they should take place, what they should contain and how information should be reported, will be set out in *city* guidance.[12]

1.3 Delivering on the net zero carbon goals of [City] presents a unique opportunity to follow a low-carbon and climate-resilient development path that creates a more inclusive urban society, with new protections for the groups that have been historically marginalized.

As outlined in C40 Cities Clean Construction Technical Note,[13] inclusivity in climate action planning is where efforts are made to ensure:

- Engagement of a wide range of communities and stakeholders (inclusivity of the process)
- Fairness and accessibility in design and delivery (inclusivity of the policy)
- Wider benefits of action as equitably distributed as possible (inclusivity of the impact).

In addition, the Technical Note also recommends that applied to the construction and buildings sector, inclusivity requires analysis of major developments to combat and avoid systemic inequalities and racial discriminations. An equity analysis for a project should consider:

- For who is it built and who will be the immediate end user
- Who benefits from it and who is affected by it
- Where is it built
- By who is it built
- What is the history of the urban planning policies of the area and its role in cementing lasting racial inequalities.

1.4 The green transition should also be just and decent. The workforce of the high-impact construction industries, such as cement and steel, must be encouraged and supported in reskilling, upskilling and training to provide them with decent and green construction jobs opportunities. The same applies to informal construction workers, recognizing when they use sustainable methods and sustaining those while providing them with adequate social protection.

2.1 The energy hierarchy (Figure 1) should inform the planning, design, construction and operation of new major development.[14] The energy efficiency first principle prioritizes minimizing energy demand, and then addresses how energy will be supplied and renewable technologies used.

2.2 Major developments must be designed and constructed to ensure the elimination of fossil fuels like gas and electric resistance from onsite energy procurement. The elimination of gas and electric resistance heating systems as part of on-site energy procurement should be replaced by more sustainable and carbon-neutral alternatives.

2.3 Operational emissions will make up a declining proportion of a development's whole life carbon as operational carbon targets become more stringent and energy supplies decarbonize. To fully capture a development's carbon impact, a whole life-cycle approach is needed to capture all emissions associated with the development from its construction through demolition and disposal.

3.1 The embodied carbon hierarchy (Figure 2) should inform planning, design, construction, maintenance and deconstruction/demolition of major developments. The priority is to minimize embodied carbon and address how assets will be used and repurposed over time.

3.2 Major developments must prioritize the use of renewable energy as their first choice for energy procurement in the life cycle of the major development.[15]

3.2.1 [City] should ensure that all major developments maximize opportunities for on-site electricity and heat production from solar technologies (photovoltaic and thermal) and use local and low-carbon or regenerative (innovative) materials. This approach will reduce carbon emissions, reduce energy costs to occupants, improve [City]'s climate resilience and support the growth of green jobs.

3.3 [City] should ensure all major developments maximize opportunities for inclusivity and just transition. Example opportunities include:

- Ensuring energy savings are felt by residents
- If energy efficiency approaches are taken ensure that this helps residents
- Ensuring no negative cost is borne by end users, especially the most vulnerable and disenfranchised.

Definitions

Electrical resistance: This refers to electric heating systems that rely on resistive heating elements to generate heat. It is a method of heating that uses electricity to produce heat directly, without the need for a combustion process.

Embodied carbon: In the built environment, embodied emissions refer to the emissions related to the extraction of raw materials, their manufacturing, assembly during construction, any maintenance or replacements, the disassembly and demolition, and any associated transport, waste and end-of- life impacts.

Environmental product declaration: An EPD quantifies the environmental impact of a product over its life cycle. The main standards for EPDs are ISO 21930 and EN 15804, with EN 15978 used as a whole building LCA standard.

Fuel gas: This includes, but is not limited to, butane, coal, crude oil, ethane, fossil fuels, hydrogen, kerosene, liquefied petroleum, manufactured petroleum, methane, natural gas, natural petroleum, oil, petrol, propane and/ or any mixture of these.

Major development: There are a variety of interpretations of this term, which includes retrofits, renovations and refurbishments. Some definitions, for example, rely on the total cost of the renovation as a portion of the market value of the structure, or the number of occupants that must relocate while works are taking place. In this policy model, major developments are those that require planning approval, including retrofit, renovation, refurbishment and new construction.[16]

Net-zero carbon: In construction, the UK Green Building Council defines net-zero carbon as the amount of carbon emissions associated with a building's product and construction stages up to practical completion is zero or negative, through the use of offsets or the net export of on-site renewable energy. The council defines net-zero carbon in operational energy as the amount of carbon emissions associated with the building's operational energy on an annual basis is zero or negative. A net-zero carbon building is highly energy efficient and powered from on-site and/or off-site renewable energy sources, with any remaining carbon balance offset.[17]

Net-zero city: A city is considered net zero when its carbon emissions are balanced with their carbon reduction and sequestration efforts. Local definitions should be followed.

Operational emissions: These are the emissions associated with the energy used to operate a building or in the operation of infrastructure. It includes how built assets are powered, heated and cooled. C40 Cities's Net Zero Carbon Buildings Accelerator addresses the operational phase of buildings, aiming to have all new buildings operate at net-zero operational carbon by 2030, and all buildings by 2050. The Clean Construction Accelerator complements it by specifically addressing the embodied emissions of buildings and infrastructure.

Regulated emissions: These are emission standards that follow legal requirements governing air pollutants released into the atmosphere.

Renewable energy: Renewable energy is generated from sources of energy that can naturally replenish themselves, such as wind, solar, water, geothermal energy and modern biomass.[18] Hydrogen (and its various uses under different forms) is considered renewable if it is produced from renewable energy sources (such as wind or solar powered water electrolysis).

Renewable energy system: This is photovoltaic, solar thermal, geothermal energy and wind systems used to generate electricity.

Whole life carbon: Whole life carbon emissions refer to all the emissions emitted throughout the life cycle of a building or piece of infrastructure. This starts with the extraction of the raw materials, their manufacturing into construction products, the construction process, maintenance, repairs, the operation of the building, deconstruction, demolition and the impacts of construction and demolition waste, as well as all the transport needed along the way.

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About the G20 Global Smart Cities Alliance

The G20 Global Smart Cities Alliance accelerates the responsible adoption of technology for urban transformation goals. Established in June 2019, the alliance unites municipal, regional and national governments, private sector partners and cities' residents around a shared set of principles for the responsible and ethical use of smart city technologies. The World Economic Forum, the International Organization for Public-Private Cooperation, serves as secretariat for the alliance. Through the G20 Global Smart Cities Alliance, global experts from government, private sector partners and civil society are compiling and analysing policies from around the world to identify model policies necessary for successful, ethical smart cities.

More model policies and details about the alliance can be found at: https://globalsmartcitiesalliance.org/.

Endnotes

1. Whole life carbon is a subset of whole life emissions, specifically focusing on the quantification of carbon emissions associated with a building or infrastructure project throughout its entire lifecycle.

2. What COP27 Meant for Architecture and the Construction Industry | ArchDaily

3. UN DESA (2018) The World's Cities in 2018: Data Booklet. New York: United Nations Department of Economic and Social Affairs.

4. This definition comes from C40 Cities' technical note for the Clean Construction Accelerator.

5. RICS is primarily used in practice in the United Kingdom. The definition pulled out is applicable to WLCA, but other international standards/guidance documents may be more appropriate to implement depending on location.

6. This policy's scope specifically centres on whole life carbon assessments, emphasizing the evaluation of carbon emissions throughout a building or infrastructure project's entire lifecycle rather than encompassing broader whole building life cycle assessments (WBLCA). WBLCAs have a broader scope that also looks at environmental aspects of the building such as water use, waste generation and resource depletion.

7. Whole Life Carbon Assessment for the Built Environment, RICS Professional Standard, 2nd edition - RICS iConsult

8. Widely recognized and used international assessment frameworks such as EN 15978 (a European standard), RICS, (England specific), *ASHRAE/ICC 240p (when available)*, are assessment frameworks that specify the WLC calculations based on LCA and other quantified environmental information. World GBC recommends EN 15978 with minimum required reporting on Modules A1-5, B1, B4, B5, B6, C1-4, and D (reported separately). Local and regional-specific reporting standards may be appropriate and should be practiced accordingly

9. This policy strives to minimize the performance gap between design theory and actual energy use and emissions. This information will aid in the understanding of why more buildings are not meeting design performances.

10. C40 Cities Embodied Carbon Reduction Hierarchy

11. This policy is a crucial step in the goal of net zero, but should not be seen as the solution to net zero. By understanding where and how carbon flows through a city, additional policies and solutions can be implemented to achieve the ultimate goal of a net-zero carbon city.

12. Example guidance document for the policy will be published following the publication of this policy.

13. Sections 1.3 and 1.4 are derived from the C40 Clean Construction Accelerator Technical Note and C40 Cities Equity Pledge.

14. Energy should be produced cleanly through renewable energy and or should follow local green energy mandates.

15. The hierarchy for renewable energy is as follows: on-site renewable energy is to be prioritized first and foremost, followed by off-site generation, followed by procurement.

16. This definition comes from C40 Cities' technical note for the Clean Construction Accelerator.

17. Net-Zero-Carbon-Buildings-A-framework-definition.pdf (ukgbc.org)

18. Modern biomass refers to processed biomass in contrast to traditional biomass, which refers to the use of local solid biofuels (wood, charcoal, agricultural residues and animal dung) burned with basic techniques, such as traditional open cookstoves and fireplaces. Modern biomass needs to be produced, processed and used in a sustainable and efficient way without causing deforestation, or degradation of habitats or loss of biodiversity.

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